

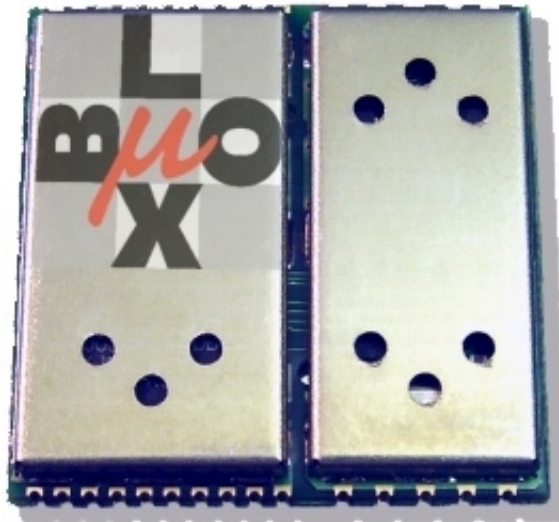


# TIM

## ACTIVE ANTENNA SUPERVISOR

### APPLICATION NOTE

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# 1 HARDWARE OVERVIEW

The active antenna supervisor provides a means to check the active antenna for open and short circuits and to shut the antenna supply off if a short circuit is detected.

## 1.1 Interfacing to TIM

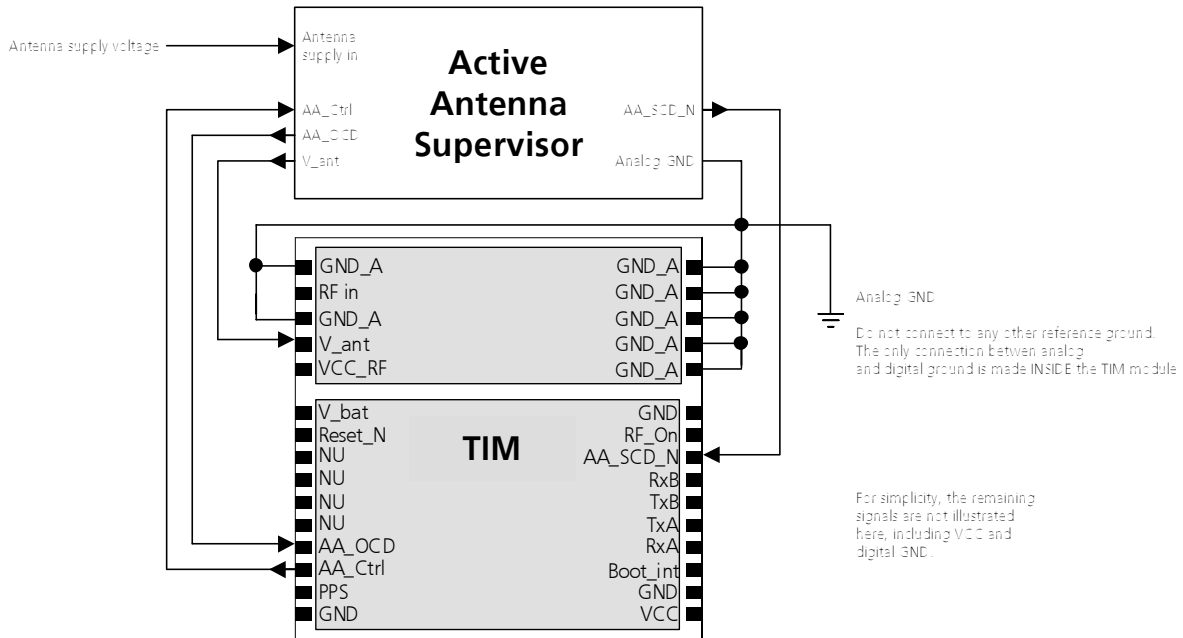


Figure 1-1: Interface diagram to TIM module

Symbol	TIM	Supervisor	Description	Signal levels
AA_Ctrl	Output	Input	Controls supply to antenna	0 = Off 1 = On
AA_SCD_N	Input	Output	Short circuit detection (Active-low signal)	0 = Short circuit detected 1 = No short circuit
AA_OCD	Input	Output	Open circuit detection	1 = Open circuit detected 0 = No open circuit detected
Antenna supply in	-	Input	Supply voltage	3.3V - 5 V nominal
V_ant	Input	Output	Controlled antenna supply	

Table 1-1: Signal description

## 1.2 Schematic

Figure 1-2 illustrates the recommended schema for the active antenna controller and supervisor. Please note that u-blox does not consider this as a guaranteed design.

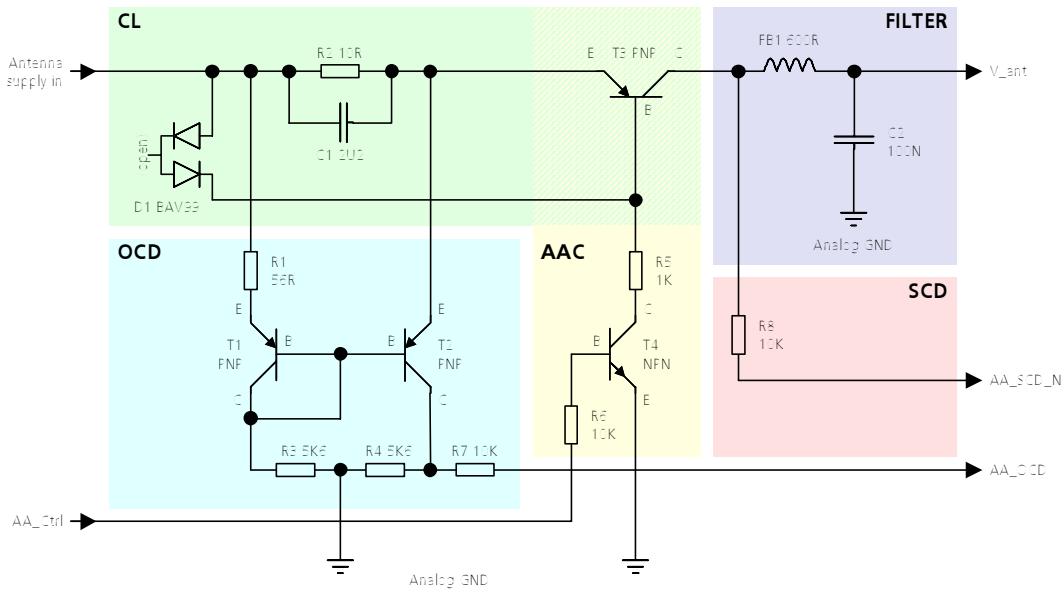


Figure 1-2: Schematic of Active Antenna Supervisor

## 1.3 Theory of Operation

### 70 mA Current limiter (CL):

The dual diode (D1) generates a voltage drop of 1.4 V and is connected to the base of the switching transistor T3. At low currents, the voltage drop across R2 is small (less than 0.75V) and ( $V_{EE}$ ) across T2

The current mirror situation would be given if the voltage drop over R1 and R2 would be the same. In that case, both transistors T1 and T2 would show the same collector current, roughly (supply voltage - 0.7V) / 5.7KOhm. If the current across R2 increases, the voltage drop builds up, the base-to-emitter voltage ( $V_{EE}$ ) across T2 will drop, reducing the collector current.

### Open circuit detection (OCD):

The open circuit detection circuit uses the current flow to detect an open circuit in the antenna. The threshold current is at 3-5 mA. A current below 3 mA will definitely indicate open circuit. A current above 5 mA will definitely indicate no open circuit.

If the current through T2 is large, the voltage drop through R4 and therefore **AA\_OCD** will be high, indicating an open connection. On the other hand, if the current is small, **AA\_OCD** will be low.

### Active antenna control (AAC):

**AA\_Ctrl** controls the base of T4. If low, no current flows from collector to emitter at T4 and therefore no voltage drop is established over D1, leading to a high base voltage at T3 and therefore suppressing current flow through T3. If **AA\_Ctrl** is high, the current  $I_E$  will flow through T4, allowing to build up a voltage drop across D1, and therefore opening the transistor T3.

### Short circuit detection (SCD):

A short circuit in the active antenna pulls **V\_ant** to ground. As a result, **AA\_SCD\_N**, is also pulled to ground.

### Filtering circuit (FILTER):

The ferrite bead acts quasi as a 0 Ohm resistance at DC levels and as 660 Ohm resistance negligible imaginary component in the GPS frequency range. The remaining LC filters out high frequency emissions coming from the TIM module.

## 1.4 Bill of Material

The following bill of material is recommended for the active antenna supervisor.

References	Value	Tolerance	Description	Manufacturer
C1	2.2 $\mu$ F	X7R specification	Capacitor, X7R, min 10V	
C2	100 nF	X7R specification	Capacitor, X7R, min 10V	
D1			Double Diode BAV99	Philips
FB1	600 $\Omega$		Ferrite Bead	E.g. Murata BLM18HD601SN1
R1	56 $\Omega$	$\pm 10\%$	Resistance, min 0.063 W	
R2	10 $\Omega$	$\pm 10\%$	Resistance, min 0.125 W	
R3, R4	5.6 K $\Omega$	$\pm 10\%$	Resistance, min 0.063 W	
R5	1 K $\Omega$	$\pm 10\%$	Resistance, min 0.063 W	
R6, R7, R8	10 K $\Omega$	$\pm 10\%$	Resistance, min 0.063 W	
T1, T2, T3			PNP Transistor BC856B	Philips Semiconductors
T4			NPN Transistor BC846B	Philips Semiconductors

**Table 1-2: Bill of material**

A note on transistors: Transistors from other suppliers with comparable electrical characteristics may be used.

## 2 SOFTWARE OPERATION

The TIM firmware (Release Dnnn and higher) provides a built-in software control for this active antenna supervisor.

### 2.1 Configuration and Control

Configuration is possible in the firmware during the download procedure using the Firmware Update Utility. Before a download is made, the user parameter "ActiveAntenna" in the tab "General Settings" must be enabled. See [3] for details on using Firmware Update Utility to make download.

This will automatically activate **AA\_Ctrl** and the antenna monitoring software watching the signals at the TIM inputs **AA\_OCD** and **AA\_SCD\_N**. For the time being, a dynamic control of **AA\_Ctrl** using input messages is not supported

**AA\_Ctrl** will be turned on once at firmware initialization if "ActiveAntenna" is enabled. If "ActiveAntenna" is disabled, then **AA\_Ctrl** will remain in tri-state.

If TricklePower™ or Push-to-Fix mode is enabled, then **AA\_Ctrl** will be turned off before the module goes into sleep mode and will be turned back on when waking up, unless a short has been detected. For obvious reasons, the software will not do any monitoring during the sleep phases.

### 2.2 Monitoring

Following "HW Status" messages provide status information from the active antenna supervisor:

- NMEA \$PSRF161
- SiRF<sup>®</sup> binary message 100 (0x64)

Both messages provide a byte called "Antenna Status" which can take following values:

Byte Value	Description	Detected Signals
0	Active antenna on and OK	<b>AA_OCD</b> = '0' and <b>AA_SCD_N</b> = '1'
1	Open circuit in antenna	<b>AA_OCD</b> = '1'
2	Short circuit in antenna (will turn antenna supply off)	<b>AA_SCD_N</b> = '0' detected at least once after power-up or reset
3	Active antenna off	Will only apply during sleep mode if a low power mode is enabled.
4	Passive antenna	User parameter ActiveAntenna is disabled

Table 2-1: Active Antenna Status

The structure of the messages is described in the *Protocol Specification* [4]. The sequential approach is illustrated in the following flowchart.

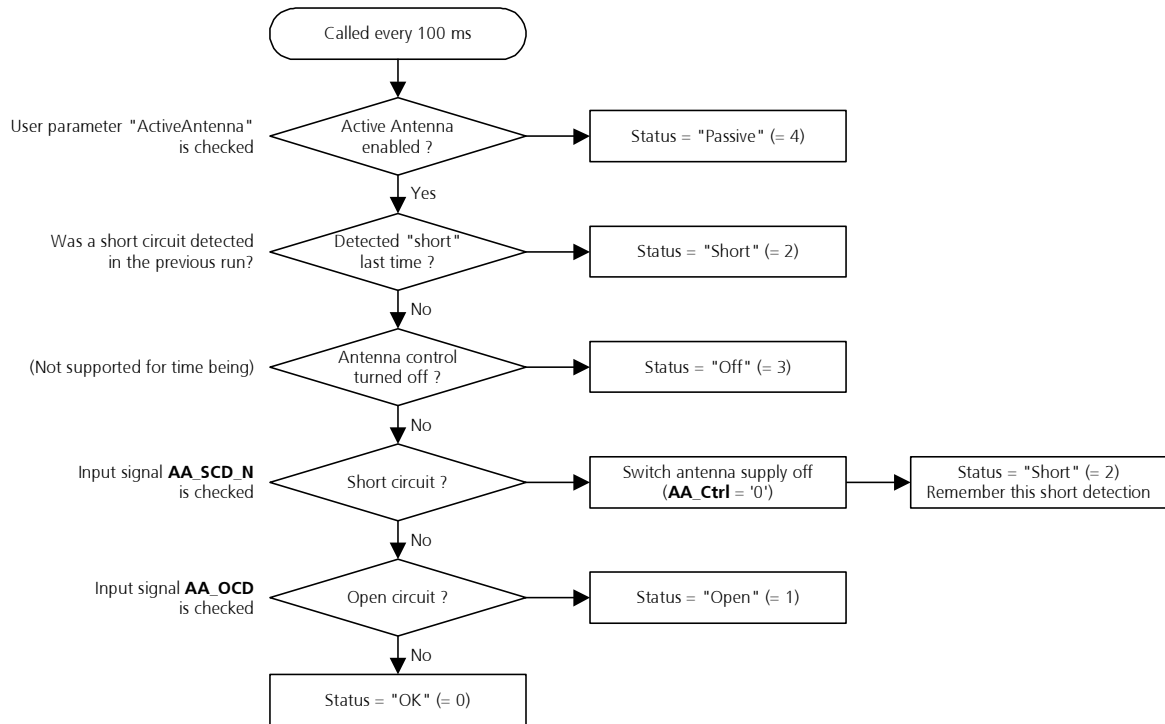


Figure 2-1: Antenna supervision flowchart

**Important notice on short circuit detection:**

If a short circuit is detected, the receiver will remain in a "safe" mode with the antenna supply turned off. The receiver must undergo a reset in order for the antenna supply to be turned back on.



## A RELATED DOCUMENTS

- [1] TIM Data Sheet, GPS.G2-MS2-01001
- [2] TIM RF and Layout Application Mode, GPS.G2-X-02005
- [3] TIM Firmware Update Utility - User's Manual, GPS.G2-SW-02004
- [4] TIM GPS Receiver - Protocol Specification - Application Note, GPS.G2-X-01003
- [5] The GPS Dictionary, GPS-X-00001

All these documents are available on our homepage (<http://www.u-blox.com>).

## B GLOSSARY

Please refer to the *GPS Dictionary*, [5].

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